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SELECTIVE BLACK TYPE PRIVACY DISPLAY WITH ANGLE ADJUSTABLE MINI-LED

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Selective black type privacy display with angle adjustable mini-LED

Abstract

This paper discloses a new type of privacy display with selective privacy area. The display replaces the conventional edge type LED backlight with direct type LED backlight. Each LED can be angle adjustable individually. When operate in sharing mode, all LED are normal direction. When operate in privacy mode, the system determines where is the selective privacy area and calculate the center of the area. All LED under this area would rotate toward the center of the area.

Background

A conventional LCD display includes a backlight unit (BLU), a thin film transistor (TFT) substrate, a liquid crystal (LC) layer, and a color filter (CF) substrate. The BLU includes a light guide plate and LED on the edge of the light guide plate. Sometimes when the user is watching confidential content on the screen, he/she would like some privacy to prevent other people peeking at it. However, such function is not available in the conventional display.

Privacy display is a display that the screen can be seen within certain angle (e.g. 45degree), and the screen cannot be easily seen outside that certain angle. This angle can also be known as the privacy angle. However, the conventional privacy display only provides privacy for entire screen. There is no option of selective area privacy screen. But sometimes the user would love to have such function for different reasons. For example, the confidential content may only cover a small area of the screen.

Invention Description

In our proposed design, we replace the edge type LED by the direct type LED, which is placed directly beneath the display module. There could be hundreds or thousands of LEDs, or even more. They are arranged as a matrix. Most importantly, the angle of each LED can be adjustable individually. Normally the LED angle is 0 degrees, the light output goes to top direction with wide viewing angle. But the LED angle can be adjusted, say to 15 degrees, the light output angle is thus rotated by 15deg. And therefore the viewing angle is reduced by 15 degrees. Thus limited people sitting at large angle to see the content on the screen. The design can also be understood in Figure 1.

During the operation, the system determines whether to operate in sharing mode or privacy mode. In sharing mode, all LED are angled at the normal, default direction. In privacy mode, the system further determines where is the selective privacy area and calculate the center of the area. Then all LED under this area rotate toward the center of the area.

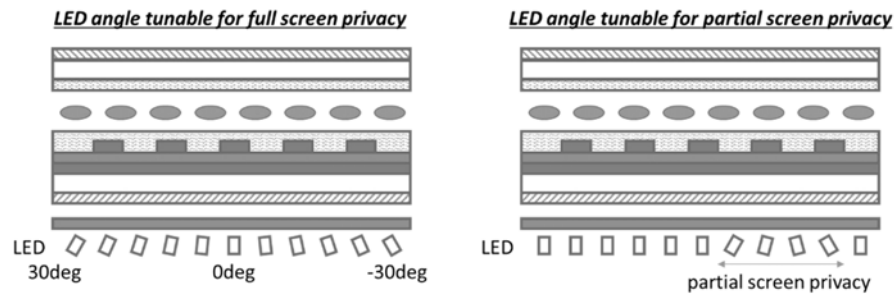


Figure 1. Cross section of the proposed display with angle adjustable LED. (Left) The display showing full screen privacy with all LEDs rotate toward the center of the screen, (right) the display showing partial screen privacy with LEDs in selective area rotate toward the center of the selective area.

Advantages

- A display capable of showing black type privacy in selected area.
- Partial selective area privacy could also prevent other people to notice that the user is using the privacy mode.
- Further, partial selective area privacy could also save power consumption. Because when the LED is rotated, partial of light would not output to the user. Given the same brightness, power at LED rotated area would be higher than normal area. This invention provides the option to choose only a limited area for privacy so power impact is minimum.
- Better user scenario and flexibility for the privacy function.

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